

Closeout Discussion

The start of the close-out discussion dealt with multigap spokes. While they are of interest to improve the real-estate gradient of low- β accelerator sections, there is a limit to their usefulness. Very long multi-gap structures do not allow the failure tolerance that is required for applications like RIA or ADS type machines.

Shepard summarized: The advantage of low- β SC structures is that they are short and can be independently driven. Transverse focusing elements can be inserted frequently, which makes them very flexible and useful for high current operation. Proposals for longer structures to reduce cost and increase the real-estate gradient need to show that this advantage is not compromised. No single design will be appropriate for all applications and beam velocities. He acknowledged that the spoke prototypes build and tested by different groups recently, show that cleaning techniques have established these structures as viable candidates for accelerating fields around 10 MV/m. While this demonstrates field wide advantages for spoke resonators in general, detailed implementations, like the number of gaps need to be adapted to the specific application.

Wangler explained that there are limits to the improvement of real-estate gradients for classic separate function beam dynamics (acceleration separated from transverse focusing), especially at low beam velocities. For space-charge dominated beam the longitudinal phase advance per cavity is limited to 90 degrees, else envelope instabilities would be excited. Without space-charge the longitudinal phase advance limit is 180 degrees (Matthew instability). The effect is proportional to β^2 , f^{-1} and $1/L_{\text{focus}}^2$. This means that the problem increases rapidly with decreasing beam velocity and with increasing focusing length. The frequency dependency is weaker, which makes it worse for proton acceleration than for ion acceleration. On Shepards suggestion more details on this issue have been written up by Tom and are added to these proceedings. Facco confirmed that their designs as based on the limitations described. For very low beam velocities they have a succession of single, short cavities and transverse focusing elements. The beam-dynamics showed that they had to limit the gradient to avoid instabilities. This scheme limits the real-estate gradient. There was general agreement that especially for longer linacs this is not a big hit on the overall efficiency.

Shepard concluded from this that high gradients in a short structure would not be a bad thing in that context, as the focusing length is short. Pierini added that for very high gradients that can be achieved in TESLA class structures Wangler's comments do also hold true.

Bisoffi mentioned that for a recent Legnaro design for a FODO length of 1m 1.2 - 1.3 MV/m real-estate gradient have been achieved. Wangler responded that for AAA up to 12 MeV 0.7 MV/m was the largest stable gradient. Beyond 20 MeV no limitations were seen anymore.

To avoid these instabilities the CH structure with its non-standard focusing concept is very interesting. Sauer mentioned that up to 120 degrees of phase advance per cavity have been achieved.

The final discussion was related to the electromagnetic difference between the CH structure and multigap spoke structures. Sauer listed the girders

connecting spoke bases as the major difference. These girders add field stability to these long structures. Zaplatin responded that some of his designs also used these girders and that electromagnetically there was no difference beyond the field stability and the peak surface fields. Thus the only difference seems to be the operational difference in a changing RF-phase between the beginning and the rest of the structure.

The workshop was closed out with two questions: The first suggesting to find a better name than "drifttube structures" for all these loaded (quarterwave, halfwave and spoke structures). No name was suggested. The second question asked if a second of these workshops should be held may be in two years. No volunteers came forward at this point.